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## Section II. REMARKS

### Cancellation of Claims 39-60, 62, 68-69, and 72-76

Consistent with the Examiner's requirement on page 2, first paragraph of the September 23, 2004 Final Office Action, Applicants therefore have cancelled claims 39-60, 62, 68-69, and 72-76.

The cancellation of claims 39-60, 62, 68-69, and 72-76 herein is with express reservation of the right to file a divisional patent application directed to the subject matter of such cancelled claims, during the pendency of the present application or during the pendency of a further continuation or divisional patent application based on and claiming the priority of the present application.

### Response to the §103 Rejection of Claims and Traversal Thereof

In the September 23, 2004 Office Action, the Examiner finalized the rejections of claims 61, 63-67, 70, and 71 on previously raised art grounds. Specifically, the Examiner rejected:

claims 61 and 63-67 under 35 U.S.C. §103(a) as being obvious over Akasaki et al. U.S. Patent No. 4,855,249 (hereinafter "Akasaki") in view of Gmitter et al. U.S. Patent No. 4,883,561 (hereinafter "Gmitter") or Bozler et al. U.S. Patent No. 4,837,182 (hereinafter "Bozler"); and

claims 70-71 under 35 U.S.C. §103(a) as being obvious over Akasaki in view of Gmitter or Bozler, and further in view of Manasevit U.S. Patent No. 3,922,475 (hereinafter "Manasevit").

In response, Applicants have hereby amended independent claim 63, from which claims 64-67 respectively dependent.

Applicants respectfully traverse the Examiner's rejections of claims 61, 63-67, 70, and 71, based on the following patentable distinctions between the claimed invention and the cited references.

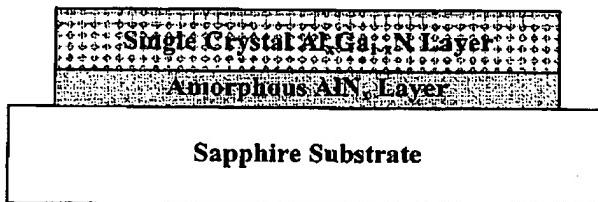
Claim 61 of the present application expressly requires:

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- "61. A method of making a single crystal GaN substrate, comprising growing single crystal GaN over a substrate heterogeneous to GaN, and removing the heterogeneous substrate to yield the single crystal GaN substrate."

Claims 63, from which claims 64-67 depend, and claim 70, from which claim 71 depend, of the present application recite corresponding requirements.

As previously pointed out and expressly conceded by the Examiner, the primary reference Akasaki only discloses a process for growing a single crystal AlGaN layer on a heterogeneous sapphire substrate that has an amorphous AlN<sub>x</sub> (X>0) layer thereon, as shown below, but it does not in any manner teach, suggest, or even contemplate the removal of such heterogeneous sapphire substrates (see Akasaki, column 3, lines 30-43, Table 1, and column 4, lines 6-21).



In attempt to remedy such deficiency of Akasaki, the Examiner cited two secondary references Gmitter and Bozler, which disclose methods for removing epitaxial or crystalline films from the respective substrates. The Examiner asserted that it would have been obvious to a person of ordinary skill in the art at the time of the present invention to modify the process disclosed by Akasaki, by using the methods disclosed by Gmitter and Bozler to remove the single crystal AlGaN layer from the heterogeneous sapphire substrate, so as to yield Applicants' claimed method (see the Final Office Action, page 3, lines 13-17; page 4, lines 4-8).

Applicants respectfully disagree with the Examiner, on the basis that there is no reasonable expectation of success for such hypothetical modification of the process disclosed by the Akasaki reference.

In other words, there is no reasonable expectation of success that the methods disclosed by Gmitter and Bozler can be used for separating the single crystal AlGaN layer from the heterogeneous sapphire substrate of Akasaki.

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The Gmitter reference discloses a method for selectively lifting off an epitaxial film from a single crystal substrate, by forming a thin release layer between such epitaxial film and the substrate, and then selectively etching away such release film (see Gmitter, column 2, lines 27-39). One example of such selectively etchable release layer as disclosed by Gmitter contains  $\text{Al}_x\text{Ga}_{1-x}\text{As}$  with  $x \geq 0.5$  (see Gmitter, column 5, lines 10-22 and 30-50), which can be etched away by using concentrated HF acid (see Gmitter, column 3, lines 46-47, and column 5, line 35).

The presence of a selectively etchable release layer between the epitaxial film and the substrate disclosed by Gmitter is critical for the successful separation of the substrate from the epitaxial film structure disclosed by Gmitter.

However, the Akasaki reference does not teach or suggest in any manner formation or incorporation of such a selectively etchable release layer between the sapphire substrate and the single crystal  $\text{Al}_x\text{Ga}_{1-x}\text{N}$  layer.

More importantly, hypothetical modification of the Akasaki reference, such as incorporating such a selectively etchable release layer between the sapphire substrate and the single crystal  $\text{Al}_x\text{Ga}_{1-x}\text{N}$  layer disclosed by the Akasaki reference, is not supported by any reasonable expectable of success. Akasaki specifically indicates that the crystalline characteristic of the  $\text{Al}_x\text{Ga}_{1-x}\text{N}$  layer depends on the specific substrate configuration, i.e., the sapphire substrate having an amorphous  $\text{AlN}_x$  buffer layer thereon (see Akasaki, column 2, lines 34-57, and column 4, lines 6-41). Therefore, the single crystal characteristic of the  $\text{Al}_x\text{Ga}_{1-x}\text{N}$  layer would likely be destroyed or at the very least be severely adversely affected by the incorporation of such a selectively etchable release layer which inevitably alters the substrate configuration.

The Bozler reference discloses a process for laterally growing a sheet of crystalline material on top of a single crystal substrate, either by partially masking such substrate with one or more crystal growth masks or by providing thin strips of crystalline material on the substrate to effectuate lateral overgrowth of the crystalline material, and subsequently separating the sheet of crystalline material from the substrate (see Bozler, column 3, lines 1-27, and column 21, lines 16-62).

Effectuation of lateral crystal overgrowth by using either the crystal growth masks or the thin strips of crystalline material as disclosed by Bozler is critical for the successful separation of the substrate from the epitaxial film structure disclosed by Bozler.

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However, the Akasaki reference does not teach or suggest in any manner lateral crystal growth of the single crystal Al<sub>x</sub>Ga<sub>1-x</sub>N layer, much less employment or incorporation of any crystal growth masks or thin strips of crystalline material on the sapphire substrate.

In the September 23, 2004 Office Action, the Examiner stated that the Akasaki reference could be modified, by “patterning the AlN buffer layer of Akasaki into strips... to aid in the removal of the GaN layer” (see the Office Action, page 7, lines 3-4).

Such hypothetical modification of the Akasaki reference, as proposed by the Examiner, is however not supported by any reasonable expectation of success. Specifically, there is no evidence that patterned strips of AlN can be used as lateral growth nuclei to effectuate lateral growth of GaN on a sapphire substrate.

More importantly, such hypothetical modification of the Akasaki reference, as proposed by the Examiner, would likely destroy or at the very least severely adversely impact the single crystal characteristic of the Al<sub>x</sub>Ga<sub>1-x</sub>N layer, by altering the substrate configuration and therefore defeating the purpose of the Akasaki reference.

It has been well-established that obviousness may not be established using hindsight or in view of the teachings or suggestions of the inventor. *W.L. Gore & Assocs., Inc. v. Garlock, Inc.*, 220 U.S.P.Q. 303, 311, 312-13 (Fed. Cir. 1983), *cert. denied*, 469 U.S. 851 (1984).

In this case, the Examiner attempted to combine bits and pieces of the Akasaki, Gmitter, and Bolzer references to reach a conclusion of obviousness, which is not supported by any teachings or suggestions in the references and derives solely from impermissible hindsight of Applicant's claimed invention.

The Examiner's hypothetical combination of the Akasaki reference with Gmitter or Bozler is therefore improper and cannot be used to establish a prima facie case of obviousness against Applicants' claimed invention.

The Manasevit reference does not remedy the above-explained deficiency of Akasaki, Gmitter, and Bozler.

Therefore, Applicants respectfully request the Examiner to withdraw the §103 rejection of claims 61, 63-67, 70, and 71.

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## CONCLUSION

Based on the foregoing, claims 61, 63-67 and 70-71 are now in form and condition for allowance. The Examiner is requested to issue a Notice of Allowance accordingly.

No fee is rendered payable for entry of this Response. Nevertheless, the Office is hereby authorized to charge any necessary fees associated with this Response to the Deposit Account No. 08-3284 of Intellectual Property/Technology Law.

If any additional issues remain, incident to the formal allowance of the application, the examiner is requested to contact the undersigned attorney at (919) 419-9350 to discuss same.

Respectfully submitted,



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Expires: August 10, 2005



Harry I. Moatz  
Director of Enrollment and Discipline